SIGNIFICANT FIGURES

Name ____________________

A measurement can only be as accurate and precise as the instrument that produced it. A scientist must be able to express the accuracy of a number, not just its numerical value. We can determine the accuracy of a number by the number of significant figures it contains.

1) All digits 1-9 inclusive are significant.
   Example: 129 has 3 significant figures.
2) Zeros between significant digits are always significant.
   Example: 5,007 has 4 significant figures.
3) Trailing zeros in a number are significant only if the number contains a decimal point.
   Example: 100.0 has 4 significant figures.
   100 has 1 significant figure.
4) Zeros in the beginning of a number whose only function is to place the decimal point are not significant.
   Example: 0.0025 has 2 significant figures.
5) Zeros following a decimal significant figure are significant.
   Example: 0.000470 has 3 significant figures.
   0.47000 has 5 significant figures.

Determine the number of significant figures in the following numbers.

1. 0.02 _____
2. 0.020 _____
3. 501 _____
4. 501.0 _____
5. 5,000 _____
6. 5,000. _____
7. 6,051.00 _____
8. 0.0005 _____
9. 0.1020 _____
10. 10,001 _____

Determine the location of the last significant place value by placing a bar over the digit. (Example: $1.70\bar{0}$)

1. 8040 ____________________
2. 0.0300 ____________________
3. 699.5 ____________________
4. 2.000×10^2 ____________________
5. 0.90100 ____________________
6. 90,100 ____________________
7. 4.7×10^{-8} ____________________
8. 10,800,000. ____________________
9. 3.01×10^{21} ____________________
10. 0.000410 ____________________

Name ____________________ Date ____________ Class ____________

MATH HANDBOOK TRANSPARENCY WORKSHEET 3

Significant Figures

Use with Appendix B, Significant Figures

1. For each of the measurements in the table below, determine if the underlined number is significant or not significant. Place a check mark in the appropriate box and in the box under the rule that you used to make your determination.

Measurement	Significant	Not Significant	Rule				
			1	2	3	4	5
a. 3038 m							
b. 1.561 L							
c. 0.074 mm							
d. 5050 s							
e. 3.007 km							
f. 6.10°C							
g. 821.0 g							
h. 0.560 g							

2. Determine the number of significant figures in each of the following measurements.

a. 56 m ______

b. 1104 mL ______

c. 15 pairs ______

d. 0.20 mol ______

e. 105 000 mm ______

f. 6.02 L ______

g. 0.176 kPa ______

h. 819 000.0 g ______

i. 4.030 m^3 ______

j. 0.005 42 s ______

k. 49 000 km ______

l. 7.81 kg ______

m. 7.01 m/s ______

n. 0.0021 m ______

o. 30 015 g ______

p. 90 km ______

q. 12.0 cm ______

r. 0.0305 kPa ______

s. 50 gross ______

t. 83.90 m/s^2 ______

u. 0.100 50 cg ______

v. 0.0510 kg ______

w. 6.12×10^5 mm ______

x. 4.01×10^2 s ______

y. $60\ 000 \times 10^3$ g ______

z. 1.000×10^2 kPa ______

CALCULATIONS USING SIGNIFICANT FIGURES

Name ____________________

When multiplying and dividing, limit and round to the least number of significant figures in any of the factors.

> **Example 1:** 23.0 cm x 432 cm x 19 cm = 188,784 cm^3
> The answer is expressed as 190,000 cm^3 since 19 cm has only two significant figures.

When adding and subtracting, limit and round your answer to the least number of decimal places in any of the numbers that make up your answer.

> **Example 2:** 123.25 mL + 46.0 mL + 86.257 mL = 255.507 mL
> The answer is expressed as 255.5 mL since 46.0 mL has only one decimal place.

Perform the following operations expressing the answer in the correct number of significant figures.

1. 1.35 m x 2.467 m = __________
2. 1,035 m^2 + 42 m = __________
3. 12.01 mL + 35.2 mL + 6 mL = __________
4. 55.46 g – 28.9 g = __________
5. .021 cm x 3.2 cm x 100.1 cm = __________
6. 0.15 cm + 1.15 cm + 2.051 cm = __________
7. 150 L^3 + 4 L = __________
8. 505 kg – 450.25 kg = __________
9. 1.252 mm x 0.115 mm x 0.012 mm = __________
10. 1.278 x 10^3 m^2 + 1.4267 x 10^2 m = __________

MATH HANDBOOK TRANSPARENCY MASTER 1

Scientific Notation

Use with Appendix B, Scientific Notation

Scientists need to express small measurements, such as the mass of the proton at the center of a hydrogen atom (0.000 000 000 000 000 000 000 000 001 673 kg), and large measurements, such as the temperature at the center of the Sun (15 000 000 K). To do this conveniently, they express the numerical values of small and large measurements in scientific notation, which has two parts.

A number in which only one digit is placed to the left of the decimal → $N \times 10^n$ ← An exponent of 10 by which the number is multiplied

Thus, the temperature of the Sun, 15 million kelvins, is written as 1.5×10^7 K in scientific notation.

Positive Exponents Express 1234.56 in scientific notation.

Each time the decimal place is moved one place to the left, the exponent is increased by one.

$$1234.56$$
$$1234.56 \times 10^0 = 123.456 \times 10^1$$
$$123.456 \times 10^1 = 12.3456 \times 10^2$$
$$12.3456 \times 10^2 = 1.234\ 56 \times 10^3$$
$$1.234\ 56 \times 10^3$$

Negative Exponents Express 0.006 57 in scientific notation.

Each time the decimal place is moved one place to the right, the exponent is decreased by one.

$$0.006\ 57$$
$$0.006\ 57 \times 10^0 = 0.0657 \times 10^{-1}$$
$$0.0657 \times 10^{-1} = 0.657 \times 10^{-2}$$
$$0.657 \times 10^{-2} = 6.57 \times 10^{-3}$$
$$6.57 \times 10^{-3}$$

SCIENTIFIC NOTATION

Name ____________________

Scientists very often deal with very small and very large numbers, which can lead to a lot of confusion when counting zeros! We have learned to express these numbers as powers of 10.

Scientific notation takes the form of $M \times 10^n$ where $1 \le M < 10$ and "n" represents the number of decimal places to be moved. Positive n indicates the standard form is a large number. Negative n indicates a number between zero and one.

> **Example 1:** Convert 1,500,000 to scientific notation.
>
> We move the decimal point so that there is only one digit to its left, a total of 6 places.
>
> $1{,}500{,}000 = 1.5 \times 10^6$
>
> **Example 2:** Convert 0.000025 to scientific notation.
>
> For this, we move the decimal point 5 places to the right.
>
> $0.000025 = 2.5 \times 10^{-5}$
>
> (Note that when a number starts out less than one, the exponent is always negative.)

Convert the following to scientific notation.

1. 0.005 = ____________________
2. 5,050 = ____________________
3. 0.0008 = ____________________
4. 1,000 = ____________________
5. 1,000,000 = ____________________
6. 0.25 = ____________________
7. 0.025 = ____________________
8. 0.0025 = ____________________
9. 500 = ____________________
10. 5,000 = ____________________

Convert the following to standard notation.

1. 1.5×10^3 = ____________________
2. 1.5×10^{-3} = ____________________
3. 3.75×10^{-2} = ____________________
4. 3.75×10^2 = ____________________
5. 2.2×10^5 = ____________________
6. 3.35×10^{-1} = ____________________
7. 1.2×10^{-4} = ____________________
8. 1×10^4 = ____________________
9. 1×10^{-1} = ____________________
10. 4×10^0 = ____________________

MATH HANDBOOK TRANSPARENCY MASTER **2**

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

Addition and Subtraction

Before numbers in scientific notation can be added or subtracted, the exponents must be equal.

Not equal → Equal

$$(3.4 \times 10^2) + (4.57 \times 10^3) = (0.34 \times 10^3) + (4.57 \times 10^3)$$

The decimal is moved to the left to increase the exponent.

$$= (0.34 + 4.57) \times 10^3$$

$$= 4.91 \times 10^3$$

Multiplication

When numbers in scientific notation are multiplied, only the number is multiplied. The exponents are added.

$$(2.00 \times 10^3)(4.00 \times 10^4) = (2.00)(4.00) \times 10^{3+4}$$

$$= 8.00 \times 10^7$$

Division

When numbers in scientific notation are divided, only the number is divided. The exponents are subtracted.

$$\frac{9.60 \times 10^7}{1.60 \times 10^4} = \frac{9.60}{1.60} \times 10^{7-4}$$

$$= 6.00 \times 10^3$$

MATH HANDBOOK TRANSPARENCY WORKSHEET 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.
   a. $(1.2 \times 10^5) + (5.35 \times 10^6)$

   b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$

   c. $(9.70 \times 10^6) + (8.3 \times 10^5)$

   d. $(3.67 \times 10^2) - (1.6 \times 10^1)$

   e. $(8.41 \times 10^{-5}) - (7.9 \times 10^{-6})$

   f. $(1.33 \times 10^5) - (4.9 \times 10^4)$

2. Perform the following operations and express the answers in scientific notation.
   a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$

   b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$

   c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$

   d. $\dfrac{7.8 \times 10^3}{1.2 \times 10^4}$

   e. $\dfrac{8.1 \times 10^{-2}}{9.0 \times 10^2}$

   f. $\dfrac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$

Name ______________________________ Date ______________________

Metric System Variables and Prefix Reference Chart

Common Metric System Variables

Variable	Abbreviation	Common Metric Unit
acceleration	a	meters per second^2
energy	W	joule
force	F	newton
length	l	meter
mass	m	gram
power	P	watt
pressure	P	pascal
time	T	seconds
velocity	v	meters per second

Prefix Reference for Metric Units

Prefix	Multiplier	Symbol	Example
Kilo-	1,000	k	Kilograms
Hecto-	100	h	Hectograms
Deca-	10	Da	Decagrams
Standard	1		Gram
Deci-	0.1	d	Decigram
Centi-	0.01	c	Centigrams
Milli-	0.001	m	Milligrams

Name ______________________________ Period ________ Date ____________

SI Units

Scientists all over the world use the same system of units so they can communicate information clearly. This system of measurement is called the **International System of Units (SI)**. Metric measurement is based on the number ten and makes calculations with the system relatively easy. By using the following conversion chart, converting from one unit to another is done simply by moving the decimal point:

Kilo- **Hecto-** **Deca-** _____ **deci-** **centi-** **milli-**

The blank line in the middle of the conversion chart can change depending on what we are measuring:

The unit for length is the meter (m).

The unit for mass is the gram (g).

The unit for volume is the liter (L).

PART A

What type of measurement is indicated by each of the following units? Choices are in the last column.

1. g/mL ____________	4. g ____________	7. mg ____________	density length
2. s ____________	5. cm^3 ____________	8. L ____________	mass
3. km ____________	6. mm ____________	9. g/cm^3 ____________	time volume

PART B

For each of the following commonly used measurements, indicate its symbol. Use the symbols to complete the following sentences with the most appropriate unit. Units may be used more than once or not at all.

_____ milliliter	_____ milligram	_____ kilometer	_____ centimeter
_____ kilogram	_____ millimeter	_____ second	_____ gram
_____ meter	_____ liter		

1. Colas may be purchased in two or three _____ bottles.
2. The mass of a bowling ball is 7.25 _____.
3. The length of the common housefly is about 1 _____.
4. The mass of a paperclip is about 1 _____.
5. One teaspoon of cough syrup has a volume of 5 _____.
6. Stand with your arms raised out to your side. The distance from your nose to your outstretched fingers is about 1 _____.
7. On a statistical basis, smoking a single cigarette lowers your life expectancy by 642,000 _____, or 10.7 minutes.

PART C

Convert the following metric measurements:

1000 mg = _____ g	198g = _____ Kg	8 mm = _____ cm
160 cm = _____ mm	75 mL = _____ L	6.3 cm = _____ mm
109 g = _____ Kg	50 cm = _____ m	5.6 m = _____ cm
250 m = _____ Km	5 L = _____mL	26,000 cm = _____ m
14 Km = _____ m	16 cm = _____mm	56,500 mm = _____ Km
1 L = _____ mL	65 g = _____ mg	27.5 mg = _____ g
480 cm = _____ m	2500 m = _____ Km	923 cm = _____ m
27 g = _____ kg	355 mL = _____ L	0.025 Km = _____ cm